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FOREST HEALTH PROTECTION
SOUTH SIERRA SHARED SERVICE AREA

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To: **Mike Reynolds, Superintendent, Death Valley National Park**
Mark Sappington, Chief of Resource Management, Death Valley National Park

From: State and Private Forestry, Forest Health Protection, South Sierra Shared Service Area

Subject: Bark beetle-associated mortality on Telescope Peak

Introduction

On June 29 and 30, 2022, Forest Health Protection, South Sierra Service Area (FHP) was requested to assess conifer mortality occurring on and near Telescope Peak, Death Valley National Park (see Image 1). FHP (Beverly Bulaon, entomologist) accompanied by Carolyn Mills (Natural Resource Technician), Ian Torrence (Biological Science Technician and Park Integrated Pest Management Coordinator), and Carol Fields (Biological Science Technician), hiked the main trail starting from Mahogany Flat Campground to Telescope Peak to see as much of the area surrounding the Peak as possible from the ground. Objectives for the field visit were to determine causes and extent of mortality among particular pine species being affected. This report describes FHP observations and potential discussion points that can help guide Park goals and desired conditions moving forward.

Image 1. View from Telescope Peak trail looking onto eastern slope of peak.

Background and Biology

The ecology and life history of high elevation pines is reflective of the severe conditions in alpine environments. Iconic species of the Sierra Nevada include whitebark (*Pinus albicaulis*), western white (*P. monticola*), foxtail *(P. balfouriana*), limber (*P. flexilis*), and bristlecone pines. In California, Great Basin bristlecone (*Pinus longaeva,* GB) is found in scattered, isolated populations in southern Sierra Nevada on National Forest and National Park lands. Great Basin bristlecone pines are unique, being one of the longest living trees in the world at the highest elevations in the state. Mortality in GB bristlecones from native insects or diseases is rare, that any loss detected needs further examination.

In a recent study of Great Basin bristlecone pine in two separate states, evidence of bark beetle-associated mortality and successful brood development was found that had not been previously recorded (Bentz et al. 2022). In the Wah Wah mountains in west-central Utah, a few Great Basin bristlecone pine had been attacked and killed by pinyon ips (*Ips confusus*), although brood survival was low. At Telescope Peak in the Panamint Range, Death Valley National Park, Great Basin bristlecone pine mortality was more extensive, and evidence of mountain pine beetle (*Dendroctonus ponderosae*) was found in the dying and dead trees. Similar to trees in the Wah Wah mountains, brood survival was low. Mortality of trees (limber and Great Basin bristlecone pine) on the slopes of Telescope Peak were estimated to date back nearly a decade. While most native bark beetles do not kill trees, a small subset can kill trees or contribute to their death, especially when the trees are stressed. On Telescope Peak, the bristlecones were attacked and killed by high populations of mountain pine beetles spilling over from nearby limber pines and lower elevation pinyon pines. Attacks in bristlecones were successful in killing trees but did not result in a large percentage of brood completing development. Bentz et al. 2022 concluded that a multitude of factors contributed to the increased susceptibility of Great Basin bristlecone pines to bark beetle attack, including reduced annual precipitation, prolonged and severe drought, and warmer winter temperatures. This mortality is unexpected due to highly specialized defense mechanisms evolved in bristlecone pines to reduce native insect attack and brood success.

An alarming uptick in bark beetle epidemics has been occurring throughout western forests in recent decades, with mortality sometimes exceeding that of other disturbances. Outbreaks of native bark beetles have been the primary cause, coinciding with incrementally hotter mean annual temperatures and lower annual precipitation region wide. Precipitation was historically scarce in 2013 during the California megadrought that occurred 2012-2016 which resulted in largescale tree die-off throughout the state – 163 million trees estimated killed. Increasing scattered mortality in lodgepole, foxtail, whitebark, and limber pines have been detected since 2009 on the eastern side of the Sierras and in many of these locations, FHP has constantly identified mountain pine beetle (*Dendroctonus ponderosae*, MPB) to be the primary disturbance agent.

Mountain pine beetle is a native bark beetle of western forests in North America. The ubiquitous nature of this beetle comes from its ability to attack a multitude of host trees, highly developed physiological adaptations to withstand a wider range of temperatures and self-amplify to outbreak levels when environmental conditions are optimal. This species alone has destroyed millions of acres of mature lodgepole pines in Canada and throughout the Rocky Mountains since late 1990s to present day. MPB activity is ongoing in several western states, as drought conditions have worsened. On both east and west sides of southern Sierra Nevada forests, MPB-associated mortality in whitebark and lodgepole pines continue to be detected in various locations on national forests and parks. MPB activity on the Inyo National Forest have not fully subsided where populations were detected five years ago; therefore, many areas are experiencing severe loss of mature, overstory trees.

Observations

The trail to Telescope Peak is about 7.5 miles, transitioning from single-leaf pinyon pine (*P. monophylla*) forest type to limber-GB bristlecone pines at the highest peaks. Starting at 8300 feet, dense pinyon pines are intermixed with mountain mahogany and mountain juniper. As elevation rises, limber pines are clumped in small dense stands, and pinyon pine is less prevalent. Great Basin bristlecone pines occupy the final heights with limber pines intermixed near the summit. The south-face view from the peak displays the knife edge of the east and western slopes dominated by GB bristlecone pines tightly holding onto very steep talus slopes.

In lower elevation pinyon forests, groups of old to recent mortality were visible on opposite slopes. Pockets appeared as large as 20+ trees, with recent mortality intensifying within the group or expanding around the edges (see Image 2). One group right along the trail was infested mainly by MPB rather than pinyon ips (*Ips confusus*) which is most often encountered in the Sierras. Distinctive long vertical galleries and numerous pitch tubes were noted on several trees and a few dead beetles were confirmed MPB. Mortality appeared a few years old, and no new attacks were noted nearby the trail. Pinyon pines are also host to MPB but have not yet been encountered by FHP on the east side of Sierra Nevada – pinyon ips are commonly detected causing mortality. Endemic MPB populations have been found infesting single-leaf pinyon in southern California (Bentz et al. 2014) so activity has been observed before, but at a low occurrence rate. Access to other dead trees for examination during the visit was difficult, so there is some uncertainty about what percentages of mortality are attributed to pinyon ips or MPB.

Image 2. Pinyon pine mortality pocket noted on a slope across from access road to Rogers Peak.

Hiking south to the base of Rogers Peak, limber pine stands contained both older and new mortality. In several groups at the north base of the Rogers peak, infested limber pines were found with MPB brood in teneral adult and pupal stages. Beetles were live and appeared a few weeks shy from emergence. Limber pines with crown colors of lighter green-yellow-orange – an indication of recent bark beetle attack- were estimated at 1 per 2 acres were observed on the western side of Rogers peak along the access road (see Image 3). This location had more current fading limber pines as compared to slopes surrounding Telescope Peak. A stand composed only of limber pines along the trail did not have active populations but did have evidence of older beetle infestation. Recent limber mortality was also observed further south on Telescope Peak trail where bristlecones intermixed (see Image 4).

Image 3. Limber pine mortality noted on western slope along access road to Rogers Peak. Note recent and older mortality.

Image 4. Newly fading limber pine (foreground) on east slope amongst bristlecone and other limber pines.

At a distance from the peak, bristlecone and limber pine mortality was observed with binoculars mainly on east-facing slopes. Large groups of trees appeared grey and dead, while some trees appeared to be still holding onto fine branches and red needles. Accurate species identification was limited to what could be seen from the trail; using binoculars to determine which were definitively bristlecone in the distance was difficult. However, two recently fading bristlecone pines that were examined off the trail were found to have new attacks from a possible engraver or woodborer. Mountain pine beetle galleries were easily visible on older dead trees where bark was peeling off but could not be found on nearby fading trees. The western slope of the peak was even steeper, so ability to see any

fading trees further down was not possible. From what was visible, overall activity was lessened on western slopes. From the peak looking south, the far western steep slope was noted with old mortality visible as grey standing slivers ands against green live trees. This mortality appeared much older than activity noted on the east side.

Discussion

FHP confirmed observations of Bentz et al. 2022 in their earlier examinations of Telescope Peak. During this visit, MPB attacks (estimated 2021) were observed in several limber pines surrounding Rogers Peak. Two fading GB bristlecone pines that were easy to access along the main trail were detected with unknown insect galleries under the bark. Active beetle mortality was observed in pinyon stands on adjacent hillsides surrounding Mahogany Flat Campground and Rogers Peak – these stands will need further examination to identify causal agents. FHP was able to help Park personnel with identification of signs and symptoms of general bark beetle infestation, MPB adult and brood stages and gallery patterns in comparison to other insects, along with tree fade patterns which may help indicate possible year of attack. Further monitoring is planned for later this summer with Dr. Barbara Bentz (Rocky Mountain Research Station, USDA Forest Service), FHP, and Park personnel.

The GB bristlecone pine mortality in Death Valley is concerning, not only because of the impacts to this long-lived species but because these trees were previously thought to be highly resistant to bark beetle attack. The loss of mature and older trees may impact reproductive capacity and ability for the GB bristlecone pines to rebound in affected areas. Additional concern is the changing nature of which live trees are surviving. GB bristlecones may again be susceptible to future bark beetle attacks if climate change (hotter, drier) continues to put them at risk to not just bark beetles but also other disturbance agents. There is potential for further GB bristlecone pine injury or mortality if trees are stressed (e.g. by climate change) and there is spillover from bark beetles from more susceptible pine. Thoughtful consideration of future forest and climate conditions is suggested to be factored into the management strategy to assess long-term risk. Climate trends suggest that if drought severity follow similar projections as the past two decades, bark beetle outbreaks are expected to increase due to protracted physiological stress in conifers of western forests.

The Park's objectives, goals, and desired conditions for this area will help determine course of management. Options will be novel, as treatments for prevention or suppression of pests in these forest types or species have not been thoroughly examined. Continual loss of GB bristlecone pines is not desired, but any treatment application will be difficult given the topography. Caution must be exercised as trial treatments may even exacerbate the situation. Bentz et al. 2022 did provide some suggestions in their report, and these can be considered as possible options if decided and conditions are suitable. "Trapping out" beetles using baited traps with attractant pheromone is best used as a monitoring tool rather than control option; trap lures and semiochemicals may possibly have the opposite effect of pulling beetles to a site where they would land on host trees, not into the trap. Targeted vegetation management at the lower elevations with active beetle populations may be a good initial trial treatment. This would require vigilant monitoring of seasonal MPB beetle emergence and tracking newly infested trees for treatment to prevent beetles from completing development to adults. Treatments would need to be finished before the next beetle flight the following year (2023). FHP can provide more details on monitoring MPB and treatments.

If there are further questions or concerns regarding this report, please do not hesitate to contact me.

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